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☐ 1. Document ID: US 6314242 B1

L7: Entry 1 of 18 File: USPT Nov 6, 2001

DOCUMENT-IDENTIFIER: US 6314242 B1
TITLE: Single-lens reflex view finder

Detailed Description Text (18):
By forming only the central portion of the curved surface as a planar surface nearly perpendicular to the optical axis and disposing a polygonal pyramidal or conical relief structure or a pair of wedge-shaped prisms on this planar surface, it is possible to obtain a view finder in which microprisms (split image) for the ordinary Leica size single-lens reflex camera coexists with a mat surface.

Detailed Description Text (70):
If the upper limit of -0.1 of the condition (5) is exceeded, spherical aberration and coma will be aggravated in the eyepiece, thereby making viewing performance of the eyepiece not preferable. If the lower limit of -6 of the condition (5) is degraded, in contrast, it will be impossible to reserve a space for interposing an image erecting prism or enhance a viewing magnification, thereby providing a small image to be observed.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw. Desc | Image

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☐ 2. Document ID: US 6278556 B1

L7: Entry 2 of 18 File: USPT Aug 21, 2001

DOCUMENT-IDENTIFIER: US 6278556 B1
TITLE: Prism optical system

Brief Summary Text (37):
If, in this case, the inverting prism is allowed to have the action of the objective on image formation, it is then possible to achieve structural simplification because the objective is dispensed with. For instance, if the incident and exit surfaces of the prism are made up of spherical surfaces, it is then possible for the prism to have power.

Brief Summary Text (60):
This is a condition necessary for reducing astigmatism produced at a decentered reflecting surface. In the case of a spherical surface, CX2/CY2=1. However, a decentered spherical surface produces considerable amounts of image distortion and other aberrations such as astigmatism and coma. Consequently, when the decentered surface is constructed of a spherical surface alone, it is difficult to make correction for astigmatism on the axis and so it is difficult to observe a clear image even at the center of a field of vision. To correct these aberrations, it is required that a reflecting surface that has the greatest catadioptric power in the prism optical system be constructed of a surface having only one symmetric plane, and that at least one surface conforming to condition (1-1) be located in the prism

optical system. Thus, it is possible for the first time to observe an image free from astigmatism.

Brief Summary Text (78):
Reference is then made to what power is allocated to each surface. Here let CX1-1, CX1-2, CX2-1 and CX2-3, and CY1-1, CY1-2, CY2-1 and CY2-3 represent the powers of the first and second reflecting surfaces of the first prism, and the powers of the first and third reflecting surfaces of the second prism in the X, and Y directions, respectively. In the present invention, it is important that any desired three reflecting surfaces out of the four reflecting surfaces have power in positive-negative-positive order. This condition is favorable for making correction for field curvature and coma, as in the case of a general triplet type of rotationally symmetric optical system, so that good aberration correction is achievable.

Brief Summary Text (136):
where CX3-1(2-t1) is CX3-1 for the first transmitting surface of the second prism. With this design it impossible to make effective correction of coma in particular.

Brief Summary Text (143):
Also, it is preferred that the first transmitting surface of the second prism, too, satisfy condition (13-1). With this design it is possible to make effective correction for coma in particular, when it is produced.

Brief Summary Text (147):
According to this aspect, it is possible to give power to a decentered prism optical system by constructing a reflecting surface with a rotationally asymmetric surface. If, in this case, the action of an ocular optical system is added to an inverting prism optical system constructed of two prisms, structural simplification can then be achieved because of no need of locating a separate ocular optical system apart from an inverting prism. This, in turn, makes it possible to construct compact binoculars, terrestrial telescopes, finder optical systems for cameras, etc.

Brief Summary Text (158):
More preferably, aberrations that cannot sufficiently be corrected by the prism located on the side of the viewer's pupil, especially a cylindrical form of field curvature, and coma are previously corrected by the prism having a substantially intersecting optical path, which is located on the objective side. It is thus possible to obtain satisfactory results in view of aberration correction.

Detailed Description Text (43):
It is understood that the prism optical system according to the second aspect of the present invention, too, is applicable to not only binoculars but also binocular microscopes, monocles, and monocular microscopes. Moreover, if the second aspect of the present invention is applied to a finder optical system for cameras, etc., it is then possible to design compact cameras.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 6272294 B1

L7: Entry 3 of 18 File: USPT Aug 7, 2001

DOCUMENT-IDENTIFIER: US 6272294 B1
TITLE: Real-image finder optical system

Brief Summary Text (5):
In a lens-shutter type camera, a real-image finder optical system, which is provided independently from the photographing optical system, generally includes a positive objective optical system, an erecting optical system, and a positive eyepiece optical system. In the real-image finder optical system, the objective optical system forms an inverted image which is upside down and reversed from left to right,

and the erecting optical system erects the inverted image to the proper orientation. The erected image is viewed through the eyepiece optical system. In such an erecting optical system, a Porro prism having four reflection surfaces is generally used. Further, an erecting optical system is usually provided between the inverted image formed by the objective optical system and the eyepiece optical system.

Detailed Description Text (7):
In the optical arrangements of the embodiments, it is preferable to form the exit pupil of the objective optical system 10 along the optical path from the negative lens element 11 and the positive lens element 12 in order to correct aberrations. At this time, since a bundle of principal rays is emitted from the exit pupil of the objective optical system 10 toward the image, it is understood that the farther the bundle of principal rays progresses, the larger the divergence thereof becomes. In other words, the divergence is smaller in the vicinity of the exit pupil. Accordingly, if the plane mirror 21 (the most object-side plane mirror) is positioned closer to the exit pupil, i.e., the positive lens element 12, the optical path length necessary to provide the plane mirror 21 can be made shorter. On the other hand, in a finder optical system for an optical instrument such as a camera and the like, a shape of a finder field of view is analogous (a rectangle with the major sides in the transverse direction) to the photographing area of the photographing optical system. Accordingly, the objective optical system 10 is arranged to form an image within a rectangular area, having major sides in the transverse direction, on the image forming plane 25; and the shape of the above rectangular area may be made to correspond to the shape of the emitting surface 25 of the prism 20. Furthermore, when the optical axis is deflected by the plane mirror 21, the deflecting of the optical axis in the direction along the major side of the rectangular finder field of view requires a longer optical path length than the deflecting of the optical axis in the direction along the minor side thereof.

Detailed Description Text (9):
However, in the case where the prism 20 is provided on the side of the object with respect to the image forming position 25 of the objective optical system 10, there is a possibility that transmission light quantity is reduced, and eclipse occurs in the finder field of view, because a bundle of principal rays emitted from the objective optical system 10 diverges, so that on the reflection surfaces 23 and 24, a part of the bundle of rays does not satisfy the condition of total reflection. This can be solved by providing the positive lens element 22p on the side of the object with respect to the prism 20 so that the bundle of principal rays to be incident on the prism 20 is made substantially parallel. On the other hand, it should be noted that the closer the positive lens element 22p is positioned to the exit pupil of the objective optical system 10, the stronger the power of the positive lens element 22p has to be. As a result, spherical aberration and coma occur excessively. Therefore in order to achieve optimum optical performance, it is necessary to position the positive lens element 22p closer to the image forming position 25 of the objective optical system 10. By positioning the positive lens element 22p between the plane mirror 21 and the prism 20, and the positive lens element 22p is designed to satisfy condition (1), the above described problems can be solved without providing the positive lens element 22p with excessively strong power. In other words, by placing the front focal point of the positive lens element 22p in the vicinity of the exit pupil of the objective optical system 10, the bundle of principal rays to be incident on the prism 20 can be made substantially parallel, so that the condition of total reflection is satisfied on the reflection surfaces 23 and 24. The positive lens element 22p is integrally formed on the incident surface 22 of the prism 20 in order to reduce the number of elements and reduce production costs accordingly; however, the positive lens element 22p can be made separately from the prism 20.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments

KWIC | Draw Desc | Image

☐ 4. Document ID: US 6014261 A
L7: Entry 4 of 18 File: USPT Jan 11, 2000

DOCUMENT-IDENTIFIER: US 6014261 A
TITLE: Optical system and optical apparatus

Brief Summary Text (22):
In the present invention, a space that is formed by the first, second, third and fourth surfaces of the ocular optical system is filled with a medium having a refractive index larger than 1 (a prism medium), and two of the four surfaces are provided with a finite curvature radius, thereby making it possible to correct spherical aberration, coma and field curvature produced by the second surface, which is decentered or tilted, and thus succeeding in providing the observer with a clear observation image having a wide exit pupil diameter and a wide field angle.

Detailed Description Text (84):
Further, the ocular optical system of the image display apparatus according to the present invention can be used as an imaging optical system. For example, as shown in the perspective view of FIG. 19, the ocular optical system maybe used in a finder optical system F.sub.i of a compact camera C.sub.a in which a photographic optical system O.sub.b and the finder optical system F.sub.i are provided separately in parallel to each other. FIG. 20 shows the arrangement of an optical system in a case where an ocular optical system according to the present invention is used as such an imaging optical system. As illustrated, an ocular optical system DS according to the present invention is disposed behind a front lens group GF and an aperture diaphragm D, thereby constituting an objective optical system L.sub.t. An image that is formed by the objective optical system L.sub.t is erected by a Porro prism P, in which there are four reflections, provided at the observer side of the objective optical system L.sub.t, thereby enabling an erect image to be observed through an ocular lens O.sub.c.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

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☐ 5. Document ID: US 6008948 A

L7: Entry 5 of 18 File: USPT Dec 28, 1999

DOCUMENT-IDENTIFIER: US 6008948 A
TITLE: Prism optical system

Brief Summary Text (36):
If, in this case, the inverting prism is allowed to have the action of the objective on image formation, it is then possible to achieve structural simplification because the objective is dispensed with. For instance, if the incident and exit surfaces of the prism are made up of spherical surfaces, it is then possible for the prism to have power.

Brief Summary Text (58):
This is a condition necessary for reducing astigmatism produced at a decentered reflecting surface. In the case of a spherical surface, CX2/CY2=1. However, a decentered spherical surface produces considerable amounts of image distortion and other aberrations such as astigmatism and coma. Consequently, when the decentered surface is constructed of a spherical surface alone, it is difficult to make correction for astigmatism on the axis and so it is difficult to observe a clear image even at the center of a field of vision. To correct these aberrations, it is required that a reflecting surface that has the greatest catadioptric power in the prism optical system be constructed of a surface having only one symmetric plane, and that at east one surface conforming to condition (1-1) be located in he prism optical system. Thus, it is possible for the first time to observe an image free from astigmatism.

Brief Summary Text (76):
Reference is then made to what power is allocated to each surface. Here let CX1-1, CX1-2, CX2-1 and CX2-3, and CY1-1, CY1-2, CY2-1 and CY2-3 represent the powers of

the first and second reflecting surfaces of the first prism, and the powers of the first and third reflecting surfaces of the second prism in the X, and Y directions, respectively. In the present invention, it is important that any desired three reflecting surfaces out of the four reflecting surfaces have power in positive-negative-positive order. This condition is favorable for making correction for field curvature and coma, as in the case of a general triplet type of rotationally symmetric optical system, so that good aberration correction is achievable.

Brief Summary Text (132):
where CX3-1 (2-t1) is CX3-1 for the first transmitting surface of the second prism. With this design it impossible to make effective correction of coma in particular.

Brief Summary Text (139):
Also, it is preferred that the first transmitting surface of the second prism, too, satisfy condition (13-1). With this design it is possible to make effective correction for coma in particular, when it is produced.

Brief Summary Text (143):
According to this aspect, it is possible to give power to a decentered prism optical system by constructing a reflecting surface with a rotationally asymmetric surface. If, in this case, the action of an ocular optical system is added to an inverting prism optical system constructed of two prisms, structural simplification can then be achieved because of no need of locating a separate ocular optical system apart from an inverting prism. This, in turn, makes it possible to construct compact binoculars, terrestrial telescopes, finder optical systems for cameras, etc.

Brief Summary Text (153):
More preferably, aberrations that cannot sufficiently be corrected by the prism located on the side of the viewer's pupil, especially a cylindrical form of field curvature, and coma are previously corrected by the prism having a substantially intersecting optical path, which is located on the objective side. It is thus possible to obtain satisfactory results in view of aberration correction.

Detailed Description Text (35):
It is understood that the prism optical system according to the second aspect of the present invention, too, is applicable to not only binoculars but also binocular microscopes, monocles, and monocular microscopes. Moreover, if the second aspect of the present invention is applied to a finder optical system for cameras, etc., it is then possible to design compact cameras.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

☐ 6. Document ID: US 5963378 A

L7: Entry 6 of 18   File: USPT   Oct 5, 1999

DOCUMENT-IDENTIFIER: US 5963378 A
TITLE: Zoom lens

Brief Summary Text (20):
It should also be noted that, at present, the single chip type CCD is widely used in video cameras for home use. In this case, there is no need to use a color separation prism and associated parts therewith which are prerequisite for the multiple chip type CCD used mainly in the professional video cameras. The zoom lenses for video cameras for home use have, therefore, their back focal distance and eye relief made relatively short.

Brief Summary Text (21):
In application to the video cameras using the multiple chip type CCD, however, because the color separation prism and associated parts therewith must be arranged in rear of the zoom lens, the zoom lens suffers a problem that, as compared with the

zoom lens for the video camera using the single chip type CCD, the back focal distance has to be relatively long, and the eye relief has to be sufficiently long.

Detailed Description Text (36):
In such a zoom lens, the back focal distance must be made long enough to allow insertion of, for example, a prism for color separation thereto. For this purpose, it is recommended that the refractive power of the third lens unit is made weak, while the refractive power of the fourth lens unit is made stronger than the moderate degree. If so, the diameter of the light beam incident on the fourth lens unit increases with increase of the refractive power thereof. At the same time, the possibility with which the fourth lens unit produces spherical aberration and coma is increased.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

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☐ 7. Document ID: US 5721994 A

L7: Entry 7 of 18 File: USPT Feb 24, 1998

DOCUMENT-IDENTIFIER: US 5721994 A
TITLE: Photographing apparatus for recording data on films

Detailed Description Text (4):
In the first mode of the first embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit 13 used in the first embodiment is a prism-shaped lens unit which has a reflecting surface 13a as shown in FIG. 1 and serves for photographing, from the front side of the film surface 15, character data provided by the display member 11 disposed on a top surface of a camera onto the film surface 15. Further, the main lens unit 13 has a side surface of emergence (r.sub.3) which is configured as an aspherical surface for correcting spherical aberration and coma.

Detailed Description Text (21):
In the first mode of the fourth embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit 13 is configured as a prism-shaped lens unit which has a reflecting surface and serves for photographing character data provided by the display member 11 disposed on a top surface of a camera from before the film surface 15.

Detailed Description Text (27):
In the first mode of the fifth embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit is configured as a prism-shaped lens unit which has a reflecting surface and serves for photographing, from before the film surface 15, character data provided by the display member 11 disposed on a top surface of the camera.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

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☐ 8. Document ID: US 5553052 A

L7: Entry 8 of 18 File: USPT Sep 3, 1996

DOCUMENT-IDENTIFIER: US 5553052 A
**** See image for Certificate of Correction ****

TITLE: Inclination of an objective lens in an optical information system

Detailed Description Text (13):
The light reflected by the insertion prism 201 is partly transmitted through a half mirror 203 and is made incident upon an interference fringe viewing portion 205 through an imaging lens 204. The interference fringe viewing portion 205 is provided with, for example, a CCD camera and a monitor (not shown). In the interference fringe viewing portion 205, interference fringes B which are caused by an interference of the beam transmitted through the objective lens 150 and the glass cover "A" and reflected by the flat surface 202a of the hemispherical lens 202, and the beam transmitted through the objective lens 150 and the glass cover "A" and reflected by the spherical surface 202b of the hemispherical lens 202 are viewed. A reflecting mechanism includes the flat surface 202a and the spherical surface 202b. A beam splitting mechanism includes the flat surface 202a and the spherical surface 202b. An superposing mechanism includes the flat surface 202a and the spherical surface 202b. A wavefront rotating mechanism includes the flat surface 202a. The distortion of the interference fringes B is due to a coma which is in turn caused by the inclination of the objective lens 150 with respect to the glass cover "A".

Detailed Description Text (37):
According to the third embodiment, since the visible light is emitted from the laser source 230, the interference fringes B and the image points C and D can be directly viewed by a viewer without relying upon the CCD camera. Consequently, the adjustment of the inclination of the objective lens 150 can be much more simplified. Moreover, in comparison with the arrangement in which the semiconductor laser source 101 within the photo magnetic disc apparatus 100 is employed, no aberration is caused in the light path between the LD source 101 and the insertion prism 201. Accordingly, a higher detection accuracy of the inclination of the objective lens 150 is obtained.

Detailed Description Text (41):
The two beams are rotated by approximately 180 degrees about the optical axis by the first and second Dove prisms 242 and 246, so that the two bundles are superimposed. Consequently, the interference fringes B are produced due to the coma which is the asymmetric aberration in 180 degrees directions with respect to the optical axis. The interference fringes B are converged as an image in the interference fringe viewing portion (not shown).

Detailed Description Text (45):
The degree of coma contained in the wavefront reflected by the concave mirror 240 and transmitted through the objective lens 150 is twice that of the wavefront transmitted once through the objective lens 150 and the glass cover "A", since the return light passes twice through the objective lens 150 and the glass cover "A". The wavefront containing the "double" coma is split into two wavefronts which are relatively turned by 180 degrees with respect to the optical axis by the Dove prisms to be superimposed. Consequently, the coma caused by the transmission of the wavefront through the objective lens 150 and the glass cover "A" can be viewed at a fourfold sensitivity. Namely, one interference fringe is viewed when the coma caused by the inclination of the objective lens 150 with respect to the glass cover "A" is .lambda./4. Thus, the coma can be detected at very high sensitivity.

Detailed Description Text (48):
The bundle of rays reflected by the reflecting mirror 250 has the same direction as the light reflected by the concave mirror 240 with respect to the optical axis and is transmitted through the beam splitter 252 (i.e., a beam splitting means and a beam superposing means) to be made incident upon the image forming lens 253. The bundle of rays reflected by the corner-cube prism (i.e., a wavefront rotating means) 251 corresponds to light reflected by the concave mirror 240 and the wavefront of the bundle of rays is rotated by 180 degrees with respect to the optical axis and is reflected by the beam splitter 252 to be made incident upon the image forming lens 253. Consequently, the interference fringes B caused by the coma can be viewed in the interference fringe viewing portion 205. The coma can be detected at high sensitivity similar to the fourth embodiment.

☐ 9. Document ID: US 5546228 A

L7: Entry 9 of 18 File: USPT Aug 13, 1996

DOCUMENT-IDENTIFIER: US 5546228 A
TITLE: Re-imaging optical system

Detailed Description Text (19):
A third embodiment of the present invention is described in FIG. 6. The re-imaging optical system according to the third embodiment is an example wherein a color separation prism P is provided on the side of the secondary image I.sub.2. This corresponds to color photography with a three tip camera. The color separation prism P is shown in FIG. 7. The color separation prism P is positioned in the optical path between the re-imaging optical system 10 and imaging devices 11B, 11G and 11R, which are comprised of CCDs or the like. The prism is composed of three prism blocks P.sub.B, P.sub.G and P.sub.R. A dichroic membrane DM.sub.B reflects blue light and is positioned at the composition surface of prism block P.sub.B and prism block P.sub.R.

Detailed Description Text (26):
FIGS. 8A-8E illustrate various aberrations in the re-imaging optical system according to the third embodiment. In the field curve drawing of spherical aberrations, FIG. 8A, the dashed line indicates a sine condition. In the field curve drawing of astigmatism, FIG. 8B, the dotted line indicates the meridional image surface, while the solid line indicates the sagittal image surface. Furthermore, the representation of coma in FIG. 8D illustrates situations where the image heights are 100% and 70%. The drawings of the various aberrations illustrate situations where light rays have been traced from a hypothetical exit pupil for the optical system. The drawings also illustrate the situation where the color separation prism P is inserted in the optical path between the re-imaging optical system and the secondary image I.sub.2.

Detailed Description Text (30):
FIGS. 10A-10E illustrate various aberrations in the re-imaging optical system of the fourth embodiment. In the field curve drawing of spherical aberrations, FIG. 10A, the dashed line indicates a sinusoidal condition. In the field curve drawing of astigmatism, FIG. 10B, the dotted line indicates the meridional image surface, while the solid line indicates the sagittal image surface. Furthermore, the representation of coma in FIG. 10D illustrates situations where the image heights are 100% and 70%. The drawings of the various aberrations illustrate situations wherein light rays have been traced from a hypothetical exit pupil for the object optical system. The drawings also illustrate the situation where the color separation prism P is inserted on the optical path between the re-imaging optical system and the secondary image I2.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 10. Document ID: US 5543886 A

L7: Entry 10 of 18 File: USPT Aug 6, 1996

DOCUMENT-IDENTIFIER: US 5543886 A
**** See image for Certificate of Correction ****
TITLE: Focus state detection apparatus

Brief Summary Text (14):
With the structure of the optical system in view, the common use of an optical path for both a focus detection system and finder optical system presents another problem in improving the imaging performance referred to in the aforesaid first item. Such a

problem is due to a pentagonal prism which is incorporated in the finder system. The common use of the pentagonal prism necessitates making the optical path long for the optical system which causes the photoelectric conversion element to perform reimaging for the focus detection. As compared with the conventional type such as storing a detection system at the bottom of a mirror box, the optical path is several times longer. Supposing that the length of pixel array of a photoelectric conversion element to be used is defined the same as the conventional one, it is necessary to make the imaging magnification equal for the optical system as a whole even if the length of the optical path becomes longer. Then, an optical system having a desired imaging relationship is obtainable if the reimaging lens is enlarged in analogue by a magnification equal to the portion of the optical path which has become longer than its original length. However, the application of a proportional enlargement such as this results in the enlargement of the aberration values with respect to the length after all. On the other hand, however, the allowable value of aberrations for the system as a whole is invariable. Therefore, such a corrective measure as attempted by a simple enlargement brings about a contradiction. In fact, an aberration such as a spherical aberration, coma aberration, and chromatic aberration is deteriorated more by a given magnification. Particularly, the deterioration of the spherical aberration causes a dotted image to be widened, leading to an inferior resolution of the fine pattern of an object. Accordingly, the fine pattern detection performance is degraded to cause the focus detection capability to be extremely lowered. For the reimaging optical system which needs a longer optical path as aimed at by the present invention, it is necessary to make the dotted images as small as possible as its prime design consideration.

Detailed Description Text (4):
Then, regarding the finder and focus detection system, a reference numeral 84 designates a focusing plate on which the objective image is projected by the photographing lens 81, and which, at the same time, serves to diffuse the metering light beam; 85, a condenser lens; 86, a pentagonal prism; 87, a beam splitter; and 88, an ocular. On the incidence plane of the focusing plate 84, a spherical portion 84a is formed for allowing the metering light beam to enter a matt plane 84c formed on the exit plane of the focusing plate 84 at an angle substantially vertical thereto and on the circumferential portion which is outside the metering field, a Fresnel lens is formed. A portion of the matt plane 84c corresponding to the spherical plane 84a is slightly convexed in order to correct the curvature of an anticipated imaging plane. The rays of light diffused by the matt plane 84c are refracted by the condenser lens 85 arranged behind the matt plane to match the arrangement of the ocular 88. Subsequently, the rays of light are deflected by the pentagonal prism 86 in the direction toward the ocular 88 to reach the eye of an observer after passing through the ocular 88.

Detailed Description Text (5):
The beam splitter 87 placed immediately before the ocular 88 causes a part of the light getting to the ocular to be reflected upward by a half mirror 87a and serves to effectuate the utilization of the reflected light beam for the focus detection. A light shielding mask 89 and elements thereafter constitute the focus detection system, and a reference numeral 90 designates a secondary imaging lens made of transparent plastic; 93, an iris; 94, a light guide prism; and 108, 108h1 and 108h2, the pixel arrays of the photoelectric conversion elements comprising many pixels, the pixel arrays being held by a transparent plastic package 95. The iris 93 is projected on the exit pupil of the photographing lens 81 by the secondary imaging lens 90, the condenser lens 85, and the spherical plane 84a of the focusing plate 84. Also, the secondary imaging lens 90 serves dually to project the matt plane 84c of the focusing plate onto the photoelectric conversion elements 108h1 and 108h2. The projected image of an object is blurred by the diffusing effect of the matt plane 84c and is in an expanded state.

Detailed Description Text (17):
The light emission plane 90e of the secondary imaging lens 90 is a spherical plane common to the aforesaid multi-lenses 90a to 90d, and the optical axis thereof is common to the photographing lens 81. The center of sphere of the light emission plane 90e is set at a position optically equivalent to the vicinity of the matt plane 84c of the focusing plate 84 which is the objective plane to the secondary imaging lens 90. In other words, when the length of the optical path of the pentagonal prism 86 and beam splitter 87 are converted in terms of air, the center of the matt plane 84c is substantially matched with the center of the sphere of the light emission plane 90e of the secondary imaging lens. As described earlier, the secondary imaging lens 90 provides a position on the optical axis of the matt plane

84c of the focusing plate 84 on the incident light side, and the four light beams which pass through the centers of gravity of the respective apertures of the iris 93 enter the multi-lenses 90a to 90d on the incident light side vertically. Therefore, the aforesaid four light beams are emitted from the emission plane 90e almost vertically. The optical system thus structured is a significant characteristic of the present invention.

Detailed Description Text (32):
Using the light conductive prism 94 described above, the photoelectric conversion element 107 can be miniaturized efficiently. FIG. 14 illustrates this state. In FIG. 14, a reference numeral 107 designates a photoelectric conversion element. The pixel arrays 108a1 to 108e2 correspond to the metering fields 104a to 104e, and the pixel arrays 108f1 to 108j2 correspond to the metering fields 104f to 104j. The meaning of the subscript reference marks are the same as those described in conjunction with FIG. 13. Here, the pixel arrays 108f1 to 108j1 and 108f2 to 108j2 corresponding to the metering fields 104f to 104j are positioned in a area sandwiched between the pixel arrays 108a1 to 108e1 and 108a2 to 108e2 corresponding to the metering fields 104a to 104e, and there is no wasteful area. The introduction of the light conductive prism 94 enables the efficient miniaturization of the camera main body itself by holding the optical path, not to mention the cost advantage brought about by the reduced size of the photoelectric conversion element itself.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments

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☐ 11. Document ID: US 5189486 A

L7: Entry 11 of 18 File: USPT Feb 23, 1993

DOCUMENT-IDENTIFIER: US 5189486 A
TITLE: Echelle polychromator

Abstract Text (1):
The invention relates to an Echelle polychromator and can be employed in instruments for the spectrophotometric investigation of radiation sources. It is characterized in that, connected in series with the polychromator, there is a dispersive and polychromatic illuminating device, which is formed from an entrance slit arrangement, collimator optics, prism and camera optics, the entrance slit arrangements of the polychromator and of the illuminating device consisting of a main slit for limiting the bundle in the grating dispersion direction and a transverse slit for limiting the bundle in the direction of the dispersion of the prism in the Echelle polychromator. The whole of the wavelength range, which is to be processed by the polychromator, is imaged completely with negligible aberration on the transverse slit of the Echelle polychromator as a spectrum of the illuminating device. The dispersion of the illuminating device runs in the direction of the transverse dispersion of the prism of the Echelle polychromator. The dispersion-induced geometric width of the spectrum of the illuminating device for the whole of the wavelength region that is to be processed by the polychromator is less than the width of the transverse slit of the Echelle polychromator. Parts of the bundle of rays of the spectrum of the illuminating device are blocked out by the transverse slit of the Echelle polychromator.

Brief Summary Text (13):
The basic device of the present invention is a conventional Echelle polychromator having a basic entrance slit arrangement, basic collimator optics, a basic prism, an Echelle grating, basic camera optics, and a detector arrangement

Brief Summary Text (14):
The supplemental device of the present invention comprises a supplemental entrance slit arrangement, supplemental collimator optics, and supplemental camera optics. The basic as well as the supplemental entrance slit arrangements each comprise a main slit for limiting in the direction of the grating dispersion the bundle of radiation emitted by a radiation source, and a transverse slit for limiting the light bundle of emitted radiation in the direction of the dispersion of the prism in the basic device. The entire wavelength range that is to be processed by the basic device is imaged substantially completely and with negligible aberration on the basic transverse slit as a radiation spectrum of the supplemental device. The radiation dispersion of the supplemental device runs in the direction of the transverse dispersion of the basic prism, and the dispersion-induced geometric width of the radiation spectrum of the supplemental device for the entirety of the wavelength range region that is to be processed by the basic device, is less than the width of its transverse slit. Parts of the bundle of light rays from the supplemental device are blocked out by the basic transverse slit.

Detailed Description Text (2):
The radiation from a light source 1 is imaged by means of an achromatic combination of lenses 2 on the entrance slit arrangement 3 of the supplemental dispersive illuminating device. The spherical supplemental collimator optics 4, the prism 5 and the spherical camera optics 6 are in a Czerny-Turner arrangement and produce a coma-free astigmatic image of the supplemental entrance slit arrangement 3 of the

illuminating device at the basic location of the entrance slit arrangement 7.1 with 7.2 of the basic Echelle polychromator. The tangential image is in the basic main slit 7.1 of the polychromator. The sagittal image is formed in the plane of the basic transverse slit 7.2.

Detailed Description Text (4):
In the illustrated arrangement, the basic main slit 7.1 and the basic transverse slit 7.2 of the basic entrance slit arrangement of the Echelle polychromator are disposed one behind the other. On the other hand, for the supplemental entrance slit arrangement 3 of the dispersive illuminating device, the slit knife-edges of the supplemental main slit and the supplemental transverse slit lie in one plane. The supplemental dispersion prism 5 is arranged to provide a spectrum of low dispersion perpendicular to the basic transverse slit 7.2. Parts of the bundles of the spectrum are blocked out by the basic transverse slit 7.2. The radiation passing through the basic main slit 7.1 and the basic transverse slit 7.2, passes through the spherical basic collimator optics 8, the transverse basic dispersion prism 9, the Echelle grating 10 and the basic camera optics 11 and is imaged in the focal plane on the detector arrangement 12 as a two-dimensional spectrum. The optical components are disposed in a "tetrahedral arrangement".

Detailed Description Paragraph Table (1):
TABLE 1
Illuminating (supplemental) device Entrance slit arrangement Width of transverse slit = 1,200 .mu.m Width of main slit = 60 .mu.m Collimator optics: spherical R = 200 mm Camera optics: Prism: .epsilon. = 5.degree. Basic Echelle Polychromator Entrance slit arrangement Width of transverse slit = 1,200 .mu.m Width of main slit = 40 .mu.m Collimator optics: spherical R = 1,000 mm Camera optics: Prism: .epsilon. = 25.degree. Echelle grating: 75 grooves/mm, .THETA..sub.B = 64.2.degree., .alpha. = 68.2.degree. Spectrum area = 65 .times. 50 mm.sup.2 order separation at 190 nm: 1,200 .mu.m 250 nm: 670 .mu.m 500 nm: 270 .mu.m 850 nm: 210 .mu.m

CLAIMS:

1. In an Echelle polychromator, having a basic Echelle polychromator unit that has a basic entrance slit arrangement of a basic main slit and a basic transverse slit that is disposed transversely to the basic main slit, basic collimator optics, a basic prism, an Echelle grating, basic camera optics, and a detector arrangement, the improvement comprising:

(a) a dispersive and polychromatic illuminating supplemental device for producing a radiation spectrum having a dispersion-induced geometric width, said supplemental device being connected in series before the basic Echelle polychromator, the supplemental device comprising a supplemental entrance slit arrangement comprised of a supplemental main slit and a supplemental transverse slit that is disposed transversely to the basic main slit, supplemental collimator optics, a supplemental prism having a transverse dispersion, and supplemental camera optics;

(b) said basic and said supplemental entrance slit arrangements each comprise a main slit for limiting in the direction of the grating dispersion the bundle of radiation emitted by a source, and a transverse slit for limiting the bundle of emitted radiation in the direction of the dispersion of the basic prism,

(c) the entirety of the wavelength range to be processed by the basic polychromator is imaged substantially completely with minimal aberration on the basic transverse slit as a radiation spectrum of the supplemental device;

(d) the radiation dispersion of the supplemental device runs in the direction of the transverse dispersion of the basic prism;

(e) the dispersion-induced geometric width of the spectrum of the radiation from the supplemental device for the entirety of the wavelength region to be processed by the basic polychromator, is less than the width of the basic transverse slit; and

(f) parts of the bundle of radiation of the spectrum of the supplemental device are blocked out by the basic transverse slit.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

☐ 12. Document ID: US 5140462 A

L7: Entry 12 of 18 File: USPT Aug 18, 1992

DOCUMENT-IDENTIFIER: US 5140462 A

**** See image for Certificate of Correction ****

TITLE: Optical system having image deflecting function

Brief Summary Text (3):
This invention relates to photographic system having image deflecting means and, more particularly, to a photographic system having image deflecting means in which by using a variable vertical angle prism provided in a lens system, an image blur caused by camera shake, etc. is compensated for to stabilize a photographic image, and which is suited for cameras for photography or video cameras.

Brief Summary Text (26):
Accordingly, in the vibration proof optical system using the variable vertical angle prism for compensating for the image blur resulting from camera-shake by deflecting the image in the reverse direction, as has been described above, if the decentering distortion is present, the amount of movement of the image at the central point in the image plane differs from those at the marginal points. Even though the compensation for the image blur is perfect in the center of the image frame, it is in the marginal zone that the image would diffuse. FIG. 19(C) is a result of compensation for the blur of the image of the object of FIG. 19(A) by the vibration-proof optical system having the decentering distortion.

Detailed Description Text (4):
In this embodiment, rays of light emerging from the first lens unit I are made almost afocal. When the on-axial beam incident on the variable vertical angle prism P is nearly afocal, in other words, when the angle of inclination .alpha. of the paraxial rays of the on-axial beam is nearly so small as to satisfy a condition: .vertline..alpha..vertline.<0.3<f.sub.T where f.sub.T is the focal length of the entire system, as compared with a case where it is not afocal, the decentering coma, decentering astigmatism and decentering curvature of field produced in the variable vertical angle prism are small. Hence, the correction of the spherical aberration, coma and astigmatism of a partial system of the second lens unit II to a minimum leads, in principle, to a possibility of minimizing the decentering coma, decentering astigmatism and decentering curvature of field produced, and, therefore, of lessening the number of constituent lens elements for the second lens unit II.

Detailed Description Text (63):
where f.sub.T is the focal length of the entire system. Since it implies that a positive lens unit of relatively strong power is arranged in a remote position from the variable vertical angle prism, not only the distortion with which the invention has its concern, but also other aberrations can be corrected without difficulty. So, when the focal lengths are short as exceeding the lower limits of the inequalities of condition (15) and the inequalities of condition (16), a large number of lens elements for correcting spherical aberration and astigmatism becomes necessary, although it is advantageous for correcting the distortion of each lens unit. Meanwhile, when the upper limits of the inequalities of conditions (15) and (16) are exceeded, the size of the optical system is increased objectionably.

Detailed Description Text (74):
In the invention, it should be understood that the principle of the invention can advantageously be applied even to another type of variable vertical angle prism in which, as shown in FIG. 3, a plano-concave lens P.sub.1 and a plano-convex lens P.sub.2 whose confronting surfaces are spherical with their radius of curvature having almost equal values to each other are rotated along the spherical surface relative to each other.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments

KWIC | Draw Desc | Image

☐ 13. Document ID: US 4971428 A

L7: Entry 13 of 18 File: USPT Nov 20, 1990

DOCUMENT-IDENTIFIER: US 4971428 A
TITLE: Catadioptric zoom lens

Brief Summary Text (10):
Briefly stated, the invention in one form thereof comprises from the object end a fixed catadioptric first group having a rear relay lens sub-group which creates an intermediate image, a positive variator, and a negative compensator which maybe followed by a viewing prism. The first catadioptric lens group is designed with a positive petval curvature which when combined with the zooming relay group of the lens, which naturally has a strong negative petzval curvature, provide a good correction of the field curvature, Correction of a astigmatism is also achieved. The dominant remaining aberrations left are spherical and coma. The positive variator group is divided into two subgroups separated by a large air space. The first subgroup has weak power and its main function is to provide a large positive contribution to correction of coma. The second sub group closest to the film plane, provides most of the power of the variator group. The main contributions to correction of spherical aberrations as well as other residual and chromatic aberrations, come from the second subgroup of the variator.

Detailed Description Text (2):
A lens embodying the invention as illustrated comprises a first catadioptric group G1 having a relay subgroup G12. Group G1 is followed by a variator or zooming relay group G2 which is comprised of a first subgroup G21 and a second subgroup G22. Group G2 is followed by a compensating group G3 and a stationery split prism P prior to the focal plane FP. The optical axis of the lens is indicated by the reference letter A. The purpose of the prism is to permit imaging on more than one device. For example, a video imaging device, and a camera.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments

KWIC | Draw Desc | Image

☐ 14. Document ID: US 4705363 A

L7: Entry 14 of 18 File: USPT Nov 10, 1987

DOCUMENT-IDENTIFIER: US 4705363 A
TITLE: Aberrational deterioration prevented zoom lens

Brief Summary Text (13):
Meanwhile, in the photographic optical systems for single lens reflex cameras, video cameras and cine cameras, the split prism type of distance measuring means is widely used.

Brief Summary Text (15):
Therefore, if the spherical aberration of the optical system is perfectly corrected, a light flux any height from the optical axis is focused at the same point, permitting distance measuring by the split prism to be accurately performed. Also, even if there is more or less residual spherical aberration, the accuracy of distance measurement can be maintained at some level, provided that the paired light fluxes are the same height from the optical axis. This condition is, however, satisfied only when the center of the eye of the observer coincides with the optical

axis. If the eye is out of alignment with the optical axis, the light fluxes used in distance measuring become partial light fluxes of different heights from the optical axis, making it difficult to accurately measure the distance. For example, with the photographic optical system having such a spherical aberration as shown in FIG. 7, there is a situation where one light flux l1 is of a range "b" and the other light flux l2 is of another range "c". Since the focal points of these light fluxes are different from each other, even if the image is in focus on the split prism, the split images appear to be offset, making it impossible to perform accurate distance measurement. When the center of the eye is not out of alignment with the optical axis, the light fluxes, l1 and l2 used are both of the same range "a". But such a situation is here. In most cases, light fluxes different in height from the optical axis are used.

Brief Summary Text (16):
It is to be understood from the foregoing that as most of the zoom lenses used as the photographic optical system have appreciable residual spherical aberration, this spherical aberration lowers the accuracy of distance measurement when the split prism is used for measuring distance.

Detailed Description Text (16):
FIGS. 12A and 12B show a third embodiment, where I is the first lens component for focusing, II and III are the second and third lens components for zooming respectively, and IV is the fourth lens component for forming an image. The first to the fourth lens components I, II, III, IV constitute a zoom lens. Reference symbol S identifies an aperture diaphragm, and ST a stop. An example of a distance measuring system is depicted in FIG. 5B where reference symbol M identifies a half mirror, SP a split prism, F a photographic film, and FD a finder. The opening of the stop ST is formed as shown in, for example, FIGS. 13A to 13F with a pair of expanded portions for restricting light flux symmetrically in at least one direction R.sub.SP. Preferably, in a direction of shorter distance from the optical axis, the on-axial light flux is restricted. The wedge direction R.sub.P of the split prism SP shown in FIG. 5A and the direction R.sub.SP in which the light flux is restricted almost coincide with each other. In FIG. 12A, the stop ST is added to the first lens component I so that it moves during focusing. In general, when focusing is performed by the first lens component I, a most marginal ray B of the on-axial light flux from an object at the minimum distance is incident on the first lens component I at a higher height than that of the incidence of a most marginal ray A of the on-axial light flux from an infinitely distant object (on the assumption that the full open F-number is the same). For example, when in the telephoto end, by the stop ST, the on-axial light flux for the infinitely distant object is not restricted, but the on-axial light flux for the close object can be restricted, thus making it possible to restrict spherical aberration with the close object. That is, because the light flux used in measuring the distance can be cut in portion, accuracy of distance measurement can be increased. The stop ST usable for this purpose may be formed to any shape which is not confined to those shown in FIGS. 13A-13F, providing that at least only one direction is restricted. And, the stop ST at this time is preferably spaced apart from the aperture diaphragm S by a lens system, because the off-axial light flux is not restricted. Though the illustrated embodiment of FIG. 12A has been described in connection with the stop ST movable along with the focusing or first lens component I to restrict the on-axial light flux, the stop ST may be otherwise arranged to move along with one of the lens components I, II, III, IV for zooming, for example, the second II or the third III lens component to restrict the on-axial light flux in zooming, thereby highly accurate distance measurement can be obtained over the entire zooming range.

Detailed Description Text (18):
The zoom lens shown in FIG. 8A is constructed with, three lens groups of negative, positive and negative refractive powers in this order from the front, the first lens group I being moved to effect focusing, and the first and second lens groups I and II being moved axially but in differential relation to effect zooming. The aperture diaphragm S is provided within the second lens group II. The range of focal length is f=29-82 with the full open aperture 1:4.3. The stop ST is between the second lens group II and the third lens group III in the position P at which the marginal ray L1 of the on-axial light flux corresponding to the full open aperture and the marginal ray L2 of an off-axial light flux going to the extra-axial image point intersect each other on the opposite side of at least one lens group to the aperture diaphragm S. The shape of the opening of the stop ST is similar to that shown in FIG. 13A. That is, the vertical diameter is equal to twice the height of the intersection point P from the optical axis, and the lateral distance is smaller by 10% than the

diameter to restrict both sides of the light flux. By using such an arrangement of the stop ST on the opposite side of the lens group to the aperture diaphragm S, the on-axial light flux is effectively restricted without having to influence the off-axial light flux. And, when zooming in a region of f=70-82, the stop ST remains stationary, and when zooming from f=70 to f=29, it is moved rearward. In this embodiment, the spherical aberration of about f= 70 is most rapidly over-corrected near the maximum aperture. Also with the object at a distance of 1.5 m in the telephoto end (focusing being performed by the first lens group), the spherical aberration is rapidly over-corrected. For this reason, the stop ST is used to cut the maximum on-axial light flux in the lateral direction by 10%. Therefore, the spherical aberration is at a height equal to 0.9 times the maximum. As will be understood from the aberration curves of FIG. 14, the spherical aberration for f=70 and f=82 with an object at 1.5 meters if taken at 0.9 becomes a very good spherical aberration. Therefore, when the light flux of lateral direction is used for measuring the object distance with the split prism SP, because the influence of the aberration is lesser in that direction, an accurate measurement of the distance can be made with ease, despite the center of the eye of the observer is more or less taken out of alingment with the optical axis. Also in the region of f=70-82, the speed at the full open aperture is slightly decreased to F-number=4.3827. But this value is only 1.9% slower than 4.3, falling sufficiently in the allowable range. Also the stop restricts the marginal ray of the off-axial light flux to the extra-axial to the intermediate zone of the image, thereby the coma flare is also effectively removed, contributing to an improvement of the image quality.

Detailed Description Text (19):
The zoom lens shown in FIGS. 10A-10D is constructed with four lens groups of positive, negative, positive and positive refractive powers in this order from the front and has a range of f=36-131 with F-number=4.0. An aperture diaphragm lies in a space between the second lens group II and the third lens group III, and moves along with the first lens group I when zooming. The second and fourth lens groups II and IV remain stationary during zooming, and the third lens group III moves. A stop ST lies in a space between the third lens group III and the fourth lens group IV at a location where when in the telephoto end the marginal ray of the on-axial light flux corresponding to the full open aperture and the marginal ray of the off-axial light flux going to the extra-axial image point intersect each other. The shape of the opening of the stop ST is similar to that shown in FIG. 13C likewise as has been described above. And, as zooming in a region of f=70-131, the stop ST remains stationary, and as zooming from f=70 to f=36, it moves rearward. In this embodiment, the spherical aberration of about f=100 is rapidly over-corrected near the maximum aperture. With the telephoto end when focused down to 1.5 m, under-correction of spherical aberration results. For this reason, the aforesaid stop is used to cut the height of incidence from 0.9 to 1.0, so that as the worst portion of the spherical aberration is improved, an accurate measuring of the distance becomes possible easily. Thus, in this embodiment, the stop is made to move from midway of zooming, thereby the light flux is effectively restricted. And, the direction R.sub.SP in which the on-axial light flux is restricted by the stop ST is made almost coincident with the direction R.sub.P of the wedges of the split prism likewise as in the foregoing embodiment, so that a photographic optical system of improved accuracy of distance measurement can be obtained.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 15. Document ID: US 4266849 A

L7: Entry 15 of 18   File: USPT   May 12, 1981

DOCUMENT-IDENTIFIER: US 4266849 A
TITLE: Optical objectives

Detailed Description Text (15):
First it passes through plate 44 and proceeds as a to main mirror 30 where it is reflected and passes as b into the corner cube via its concave surface 118. Then the

ray is reflected in turn from each of the three flat reflecting surfaces of the corner cube and passes as c out of the concave surface 118 to the center hole 36 of the main mirror. The other light ray 122A follows a similar path and emerges from the corner cube toward the center hole 36 of the main mirror as c'. The light rays converge at a final focus point F.sub.3. The image (which is real and erect) formed at F.sub.3 is magnified by the associated eyepiece or magnifier (not shown). F.sub.1 represents the focal point of the main mirror, F.sub.2 is the image plane that would be formed by light rays passing from main mirror 30 through the corner cube on the first encounter with the corner cube, F.sub.2 ' is the image plane that would be formed by light rays passing out of the corner cube after encountering the three mutually orthogonal surfaces of the prism, and F.sub.3 is the final focus of the system, i.e., it is the surface or plane at which the real and erect image is formed. In FIG. 5, the focal point F.sub.1 coincides with the apex of the corner cube; however, this is not a fundamental functional requirement of the invention. An essential requirement of this embodiment is that the virtual focus of the corner cube cannot coincide with the focus of the main mirror; instead the focus of the main mirror must be between surface 118 and the virtual focus of the corner cube; preferably it is between the apex of the corner cube and surface 118. The virtual focus of the corner cube is affected by the curvature of surface 118. The latter is spherical and its curvature is arranged so as to substantially balance out spherical aberrations of the main mirror. The final focus F.sub.3 of the system may be moved forward or behind the particular point shown in FIG. 5 by appropriate design of surface 118.

Detailed Description Text (25):
FIG. 7E shows a system wherein the corner cube reflector 46C is disposed in an aperture in a concave-concave lens 152 and has its apex extending into a central cavity in a convex-concave lens 154. The opposite end of reflector 46C is flat and engages a planar lens 156 which is disposed centrally of and in contact with a convex-concave lens 158. Additionally, the main mirror 30 is replaced by a flat main mirror 30B. This system may be used as a camera lens, microscope or a special purpose optical measurement instrument. It is highly corrected for spherical aberration, coma, astigmatism and color, and telephoto magnification is provided by the compound powered prism. Use of a flat primary mirror gives the system thermal stability since all of the power (exclusive of the associated eyepiece) is located at one place. In FIG. 7F the corner cube reflector 46C is disposed in a central aperture in a concave-convex lens 160 and its apex is disposed in a central aperture in a convex-concave front lens 162. The main mirror 30 is replaced by a flat main mirror 30B. This system is useful as a lens system for less expensive instruments and cameras. The doublet permits correction for sphercial aberrations and coma, and the front step 19A removes astigmatism. Use of a flat primary mirror gives the system a high thermal stability since all of the power (exclusive of the associated eyepiece) is concentrated at one location.

Detailed Description Text (44):
A system constructed according to the foregoing design criteria has an aperture of 25.4 mm (i.e. 1.0 inch) with a real field of view of 6.degree., and will exhibit an approximate magnification power of 6.times. when used with an eyepiece having a focal length of 10.311 mm. The focus of the system i.e., F.sub.3, is located 0.4743 inches from the vertex of curved surface 118 and the image will be real and erect and be substantially free of spherical and chromatic aberrations as well as being substantially fully corrected for coma, distortion and astigmatism. It is to be noted also that proper design of the curvature of surface 118 not only provides color correction but also permits a reduction in the size of the corner cube prism. This system makes it possible to provide an instrument light enough to wear and less than two inches long with fields of view of from 6.degree. to 9.degree. and power ranges of 4.times. to 10.times..

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

☐ 16. Document ID: US 4162498 A
L7: Entry 16 of 18 File: USPT Jul 24, 1979

DOCUMENT-IDENTIFIER: US 4162498 A
TITLE: Viewfinder for reflex camera

Detailed Description Text (2):
The invention may best be explained with reference to a viewfinder made in accordance with the prior art, FIG. 1, showing the construction of the essential portions of a viewfinder for a single lens reflex camera. The light flux which passes through an objective lens 1 is reflected by a mirror 2 and passes through a focusing screen plate 3 comprising parallel flat surfaces, and into a penta-prism 4 so as to be directed to an eyepiece 5. Here, the state of the image of the object focused on the mat surface provided on the exit surface 3b of the focusing screen plate can be seen by tracing the light rays. As an example of this, FIGS. 2A, 2B and 2C illustrate aberrations occurring in a case where the thickness of the focusing screen plate is 2 mm, the refractive index of the transparent medium forming the focusing screen plate is 1.49 and the objective lens 1 is an aberration-free lens for single lens reflex 35 mm camera having a focal length of 50 mm, a half-angle of view 21.degree. and a relative aperture of 1:1.4. FIG. 2A illustrates spherical aberration, FIG. 2B illustrates astigmatism and FIG. 2C illustrates coma in the meridional direction for a light flux of maximum angle of view, this figure also illustrating lateral spherical aberration by the dotted line. As seen from these aberration graphs, the image plane in the marginal portion thereof is displaced in the positive direction, and coma is very evident in this portion. The image plane becomes a convexly curved plane toward the entrance side. It has been found that these tendencies become greater with increase in the thickness and refractive index of the focusing screen plate. The focusing condition in the marginal portion of the mat surface is further aggravated.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 17. Document ID: US 4097141 A
L7: Entry 17 of 18 File: USPT Jun 27, 1978

DOCUMENT-IDENTIFIER: US 4097141 A
TITLE: Optical objectives using apertured retrodirective reflectors

Detailed Description Text (15):
First it passes through plate 44 and proceeds as a to main mirror 30 where it is reflected and passes as b into the corner cube via its concave surface 118. Then the ray is reflected in turn from each of the three flat reflecting surfaces of the corner cube and passes as c out of the concave surface 118 to the center hole 36 of the main mirror. The other light ray 122A follows a similar path and emerges from the corner cube toward the center hole 36 of the main mirror as c'. The light rays converge at a final focus point F.sub.3. The image (which is real and erect) formed at F.sub.3 is magnified by the associated eyepiece or magnifier (not shown). F.sub.1 represents the focal point of the main mirror, F.sub.2 is the image plane that would be formed by light rays passing from main mirror 30 through the corner cube on the first encounter with the corner cube, F.sub.2 ' is the image plane that would be formed by light rays passing out of the corner cube after encountering the three mutually orthogonal surfaces of the prism; and F.sub.3 is the final focus of the system, i.e., it is the surface or plane at which the real and erect image is formed. In FIG. 5, the focal point F.sub.1 coincides with the apex of the corner cube; however, this is not a fundamental functional requirement of the invention. An essential requirement of this embodiment is that the virtual focus of the corner cube cannot coincide with the focus of the main mirror; instead the focus of the main mirror must be between surface 118 and the virtual focus of the corner cube; preferably it is between the apex of the corner cube and surface 118. The virtual focus of the corner cube is affected by the curvature of surface 118. The latter is spherical and its curvature is arranged so as to substantially balance out spherical aberrations of the main mirror. The final focus F.sub.3 of the system may be moved

forward or behind the particular point shown in FIG. 5 by appropriate design of surface 118.

Detailed Description Text (25):
FIG. 7E shows a system wherein the corner cube reflector 46C is disposed in an aperture in a concave-concave lens 152 and has its apex extending into a central cavity in a convex-concave lens 154. The opposite end of reflector 46C is flat and engages a planar lens 156 which is disposed centrally of and in contact with a convex-concave lens 158. Additionally, the main mirror 30 is replaced by a flat main mirror 30B. This system may be used as a camera lens, microscope or a special purpose optical measurement instrument. It is highly corrected for spherical aberration, coma, astigmatism and color, and telephoto magnification is provided by the compound powered prism. Use of a flat primary mirror gives the system thermal stability since all of the power (exclusive of the associated eyepiece) is located at one place. In FIG. 7F the corner cube reflector 46C is disposed in a central aperture in a concave-convex lens 160 and its apex is disposed in a central aperture in a convex-concave front lens 162. The main mirror 30 is replaced by a flat main mirror 30B. This system is useful as a lens system for less expensive instruments and cameras. The doublet permits correction for spherical aberrations and coma, and the front stop 19A removes astigmatism. Use of a flat primary mirror gives the system a high thermal stability since all of the power (exclusive of the associated eyepiece) is concentrated at one location.

Detailed Description Text (44):
A system constructed according to the foregoing design criteria has an aperture of 25.4 mm (i.e. 1.0 inch) with a real field of veiw of 6.degree., and will exhibit an approximate magnification power of 6X when used with an eyepiece having a focal length of 10.311 mm. The focus of the system, i.e., F.sub.3, is located 0.4743 inches from the vertex of curved surface 118 and the image will be real and erect and be substantially free of spherical and chromatic aberrations as well as being substantially fully corrected for coma, distortion and astigmatism. It is to be noted also that proper design of the curvature of surface 118 not only provides color correction but also permits a reduction in the size of the corner cube prism. This system makes it possible to provide an instrument light enough to wear and less than 2 inches long with fields of view of from 6.degree. to 9.degree. and power ranges of 4.times. to 10.times..

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 18. Document ID: US 3886331 A

L7: Entry 18 of 18   File: USPT   May 27, 1975

DOCUMENT-IDENTIFIER: US 3886331 A
**** See image for Certificate of Correction ****
TITLE: Electronic scanning spectrophotometer system

Detailed Description Text (2):
As shown in FIG. 1, one embodiment of the spectorphotometer system of the present invention has a conventional optical system including an entrance slit 10, a first spherical mirror 12, a movable diffraction grating 14, and a second spherical mirror 16. This can be a "coma corrected Czerny-Turner" optical system like that shown in U.S. Pat. No. 3,011,391 of W. G. Fastie granted Dec. 5, 1961. An input light signal 18 containing light of many different wavelengths is transmitted through the slit in the entrance slit member 10 and is collimated and reflected by mirror 12 onto the diffraction grating 14. The diffraction grating diffracts the light at different angles according to its wavelength and the output mirror 16 focuses this light thereby transforming this angular dispersion into a linear dispersion at a focal plane 20 where a photoelectric detector 22 is positioned. Thus, detector 22 may be an image tube having a photosensitive target positioned in the image plane 20. The image tube 22 is preferably a vidicon type television camera tube having a photosensitive target in the form on a PN junction silicon diode array as shown in

U.S. Pat. No. 3,011,089 of F. W. Reynolds granted Nov. 28, 1971, or a metal to semiconductor diode array like that of U.S. Pat. No. 3,496,404 of P. H. Wendland granted Feb. 17, 1970. Of course, other optical systems can be employed and a prism or other wavelength separating element substituted for the diffraction grating 14. It should be noted that the diffraction grating 14 can be pivoted by means of a wavelength drive knob 24 to change the incident angle at which the input light signal strikes such diffraction grating so that the portion of the optical spectrum focused upon the image plane 20 of the detector tube 22 changes with different settings of knob 24.

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☐ 1. Document ID: US 6278556 B1

L15: Entry 1 of 11 File: USPT Aug 21, 2001

DOCUMENT-IDENTIFIER: US 6278556 B1
TITLE: Prism optical system

Brief Summary Text (37):
If, in this case, the inverting prism is allowed to have the action of the objective on image formation, it is then possible to achieve structural simplification because the objective is dispensed with. For instance, if the incident and exit surfaces of the prism are made up of spherical surfaces, it is then possible for the prism to have power.

Brief Summary Text (60):
This is a condition necessary for reducing astigmatism produced at a decentered reflecting surface. In the case of a spherical surface, CX2/CY2=1. However, a decentered spherical surface produces considerable amounts of image distortion and other aberrations such as astigmatism and coma. Consequently, when the decentered surface is constructed of a spherical surface alone, it is difficult to make correction for astigmatism on the axis and so it is difficult to observe a clear image even at the center of a field of vision. To correct these aberrations, it is required that a reflecting surface that has the greatest catadioptric power in the prism optical system be constructed of a surface having only one symmetric plane, and that at least one surface conforming to condition (1-1) be located in the prism optical system. Thus, it is possible for the first time to observe an image free from astigmatism.

Brief Summary Text (78):
Reference is then made to what power is allocated to each surface. Here let CX1-1, CX1-2, CX2-1 and CX2-3, and CY1-1, CY1-2, CY2-1 and CY2-3 represent the powers of the first and second reflecting surfaces of the first prism, and the powers of the first and third reflecting surfaces of the second prism in the X, and Y directions, respectively. In the present invention, it is important that any desired three reflecting surfaces out of the four reflecting surfaces have power in positive-negative-positive order. This condition is favorable for making correction for field curvature and coma, as in the case of a general triplet type of rotationally symmetric optical system, so that good aberration correction is achievable.

Brief Summary Text (136):
where CX3-1(2-t1) is CX3-1 for the first transmitting surface of the second prism. With this design it impossible to make effective correction of coma in particular.

Brief Summary Text (143):
Also, it is preferred that the first transmitting surface of the second prism, too, satisfy condition (13-1). With this design it is possible to make effective correction for coma in particular, when it is produced.

Brief Summary Text (147):
According to this aspect, it is possible to give power to a decentered prism optical system by constructing a reflecting surface with a rotationally asymmetric surface. If, in this case, the action of an ocular optical system is added to an inverting prism optical system constructed of two prisms, structural simplification can then be achieved because of no need of locating a separate ocular optical system apart

from an inverting prism. This, in turn, makes it possible to construct compact binoculars, terrestrial telescopes, finder optical systems for cameras, etc.

Brief Summary Text (158):
More preferably, aberrations that cannot sufficiently be corrected by the prism located on the side of the viewer's pupil, especially a cylindrical form of field curvature, and coma are previously corrected by the prism having a substantially intersecting optical path, which is located on the objective side. It is thus possible to obtain satisfactory results in view of aberration correction.

Detailed Description Text (43):
It is understood that the prism optical system according to the second aspect of the present invention, too, is applicable to not only binoculars but also binocular microscopes, monocles, and monocular microscopes. Moreover, if the second aspect of the present invention is applied to a finder optical system for cameras, etc., it is then possible to design compact cameras.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 6014261 A
L15: Entry 2 of 11 File: USPT Jan 11, 2000

DOCUMENT-IDENTIFIER: US 6014261 A
TITLE: Optical system and optical apparatus

Brief Summary Text (22):
In the present invention, a space that is formed by the first, second, third and fourth surfaces of the ocular optical system is filled with a medium having a refractive index larger than 1 (a prism medium), and two of the four surfaces are provided with a finite curvature radius, thereby making it possible to correct spherical aberration, coma and field curvature produced by the second surface, which is decentered or tilted, and thus succeeding in providing the observer with a clear observation image having a wide exit pupil diameter and a wide field angle.

Detailed Description Text (84):
Further, the ocular optical system of the image display apparatus according to the present invention can be used as an imaging optical system. For example, as shown in the perspective view of FIG. 19, the ocular optical system maybe used in a finder optical system F.sub.i of a compact camera C.sub.a in which a photographic optical system O.sub.b and the finder optical system F.sub.i are provided separately in parallel to each other. FIG. 20 shows the arrangement of an optical system in a case where an ocular optical system according to the present invention is used as such an imaging optical system. As illustrated, an ocular optical system DS according to the present invention is disposed behind a front lens group GF and an aperture diaphragm D, thereby constituting an objective optical system L.sub.t. An image that is formed by the objective optical system L.sub.t is erected by a Porro prism P, in which there are four reflections, provided at the observer side of the objective optical system L.sub.t, thereby enabling an erect image to be observed through an ocular lens O.sub.c.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 6008948 A
L15: Entry 3 of 11 File: USPT Dec 28, 1999

DOCUMENT-IDENTIFIER: US 6008948 A
TITLE: Prism optical system

Brief Summary Text (36):
If, in this case, the inverting prism is allowed to have the action of the objective on image formation, it is then possible to achieve structural simplification because the objective is dispensed with. For instance, if the incident and exit surfaces of the prism are made up of spherical surfaces, it is then possible for the prism to have power.

Brief Summary Text (58):
This is a condition necessary for reducing astigmatism produced at a decentered reflecting surface. In the case of a spherical surface, CX2/CY2=1. However, a decentered spherical surface produces considerable amounts of image distortion and other aberrations such as astigmatism and coma. Consequently, when the decentered surface is constructed of a spherical surface alone, it is difficult to make correction for astigmatism on the axis and so it is difficult to observe a clear image even at the center of a field of vision. To correct these aberrations, it is required that a reflecting surface that has the greatest catadioptric power in the prism optical system be constructed of a surface having only one symmetric plane, and that at east one surface conforming to condition (1-1) be located in he prism optical system. Thus, it is possible for the first time to observe an image free from astigmatism.

Brief Summary Text (76):
Reference is then made to what power is allocated to each surface. Here let CX1-1, CX1-2, CX2-1 and CX2-3, and CY1-1, CY1-2, CY2-1 and CY2-3 represent the powers of the first and second reflecting surfaces of the first prism, and the powers of the first and third reflecting surfaces of the second prism in the X, and Y directions, respectively. In the present invention, it is important that any desired three reflecting surfaces out of the four reflecting surfaces have power in positive-negative-positive order. This condition is favorable for making correction for field curvature and coma, as in the case of a general triplet type of rotationally symmetric optical system, so that good aberration correction is achievable.

Brief Summary Text (132):
where CX3-1 (2-t1) is CX3-1 for the first transmitting surface of the second prism. With this design it impossible to make effective correction of coma in particular.

Brief Summary Text (139):
Also, it is preferred that the first transmitting surface of the second prism, too, satisfy condition (13-1). With this design it is possible to make effective correction for coma in particular, when it is produced.

Brief Summary Text (143):
According to this aspect, it is possible to give power to a decentered prism optical system by constructing a reflecting surface with a rotationally asymmetric surface. If, in this case, the action of an ocular optical system is added to an inverting prism optical system constructed of two prisms, structural simplification can then be achieved because of no need of locating a separate ocular optical system apart from an inverting prism. This, in turn, makes it possible to construct compact binoculars, terrestrial telescopes, finder optical systems for cameras, etc.

Brief Summary Text (153):
More preferably, aberrations that cannot sufficiently be corrected by the prism located on the side of the viewer's pupil, especially a cylindrical form of field curvature, and coma are previously corrected by the prism having a substantially intersecting optical path, which is located on the objective side. It is thus possible to obtain satisfactory results in view of aberration correction.

Detailed Description Text (35):
It is understood that the prism optical system according to the second aspect of the present invention, too, is applicable to not only binoculars but also binocular microscopes, monocles, and monocular microscopes. Moreover, if the second aspect of the present invention is applied to a finder optical system for cameras, etc., it is then possible to design compact cameras.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

☐ 4. Document ID: US 5721994 A

L15: Entry 4 of 11 File: USPT Feb 24, 1998

DOCUMENT-IDENTIFIER: US 5721994 A
TITLE: Photographing apparatus for recording data on films

Detailed Description Text (4):
In the first mode of the first embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit 13 used in the first embodiment is a prism-shaped lens unit which has a reflecting surface 13a as shown in FIG. 1 and serves for photographing, from the front side of the film surface 15, character data provided by the display member 11 disposed on a top surface of a camera onto the film surface 15. Further, the main lens unit 13 has a side surface of emergence (r.sub.3) which is configured as an aspherical surface for correcting spherical aberration and coma.

Detailed Description Text (21):
In the first mode of the fourth embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit 13 is configured as a prism-shaped lens unit which has a reflecting surface and serves for photographing character data provided by the display member 11 disposed on a top surface of a camera from before the film surface 15.

Detailed Description Text (27):
In the first mode of the fifth embodiment, images of characters are formed on the film surface 15 by the display member 11, the aperture stop 12 and the main lens unit 13. The main lens unit is configured as a prism-shaped lens unit which has a reflecting surface and serves for photographing, from before the film surface 15, character data provided by the display member 11 disposed on a top surface of the camera.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

☐ 5. Document ID: US 5543886 A

L15: Entry 5 of 11 File: USPT Aug 6, 1996

DOCUMENT-IDENTIFIER: US 5543886 A
**** See image for Certificate of Correction ****
TITLE: Focus state detection apparatus

Brief Summary Text (14):
With the structure of the optical system in view, the common use of an optical path for both a focus detection system and finder optical system presents another problem in improving the imaging performance referred to in the aforesaid first item. Such a problem is due to a pentagonal prism which is incorporated in the finder system. The common use of the pentagonal prism necessitates making the optical path long for the optical system which causes the photoelectric conversion element to perform reimaging for the focus detection. As compared with the conventional type such as storing a detection system at the bottom of a mirror box, the optical path is several times longer. Supposing that the length of pixel array of a photoelectric

conversion element to be used is defined the same as the conventional one, it is necessary to make the imaging magnification equal for the optical system as a whole even if the length of the optical path becomes longer. Then, an optical system having a desired imaging relationship is obtainable if the reimaging lens is enlarged in analogue by a magnification equal to the portion of the optical path which has become longer than its original length. However, the application of a proportional enlargement such as this results in the enlargement of the aberration values with respect to the length after all. On the other hand, however, the allowable value of aberrations for the system as a whole is invariable. Therefore, such a corrective measure as attempted by a simple enlargement brings about a contradiction. In fact, an aberration such as a spherical aberration, coma aberration, and chromatic aberration is deteriorated more by a given magnification. Particularly, the deterioration of the spherical aberration causes a dotted image to be widened, leading to an inferior resolution of the fine pattern of an object. Accordingly, the fine pattern detection performance is degraded to cause the focus detection capability to be extremely lowered. For the reimaging optical system which needs a longer optical path as aimed at by the present invention, it is necessary to make the dotted images as small as possible as its prime design consideration.

Detailed Description Text (4):
Then, regarding the finder and focus detection system, a reference numeral 84 designates a focusing plate on which the objective image is projected by the photographing lens 81, and which, at the same time, serves to diffuse the metering light beam; 85, a condenser lens; 86, a pentagonal prism; 87, a beam splitter; and 88, an ocular. On the incidence plane of the focusing plate 84, a spherical portion 84a is formed for allowing the metering light beam to enter a matt plane 84c formed on the exit plane of the focusing plate 84 at an angle substantially vertical thereto and on the circumferential portion which is outside the metering field, a Fresnel lens is formed. A portion of the matt plane 84c corresponding to the spherical plane 84a is slightly convexed in order to correct the curvature of an anticipated imaging plane. The rays of light diffused by the matt plane 84c are refracted by the condenser lens 85 arranged behind the matt plane to match the arrangement of the ocular 88. Subsequently, the rays of light are deflected by the pentagonal prism 86 in the direction toward the ocular 88 to reach the eye of an observer after passing through the ocular 88.

Detailed Description Text (5):
The beam splitter 87 placed immediately before the ocular 88 causes a part of the light getting to the ocular to be reflected upward by a half mirror 87a and serves to effectuate the utilization of the reflected light beam for the focus detection. A light shielding mask 89 and elements thereafter constitute the focus detection system, and a reference numeral 90 designates a secondary imaging lens made of transparent plastic; 93, an iris; 94, a light guide prism; and 108, 108h1 and 108h2, the pixel arrays of the photoelectric conversion elements comprising many pixels, the pixel arrays being held by a transparent plastic package 95. The iris 93 is projected on the exit pupil of the photographing lens 81 by the secondary imaging lens 90, the condenser lens 85, and the spherical plane 84a of the focusing plate 84. Also, the secondary imaging lens 90 serves dually to project the matt plane 84c of the focusing plate onto the photoelectric conversion elements 108h1 and 108h2. The projected image of an object is blurred by the diffusing effect of the matt plane 84c and is in an expanded state.

Detailed Description Text (17):
The light emission plane 90e of the secondary imaging lens 90 is a spherical plane common to the aforesaid multi-lenses 90a to 90d, and the optical axis thereof is common to the photographing lens 81. The center of sphere of the light emission plane 90e is set at a position optically equivalent to the vicinity of the matt plane 84c of the focusing plate 84 which is the objective plane to the secondary imaging lens 90. In other words, when the length of the optical path of the pentagonal prism 86 and beam splitter 87 are converted in terms of air, the center of the matt plane 84c is substantially matched with the center of the sphere of the light emission plane 90e of the secondary imaging lens. As described earlier, the secondary imaging lens 90 provides a position on the optical axis of the matt plane 84c of the focusing plate 84 on the incident light side, and the four light beams which pass through the centers of gravity of the respective apertures of the iris 93 enter the multi-lenses 90a to 90d on the incident light side vertically. Therefore, the aforesaid four light beams are emitted from the emission plane 90e almost vertically. The optical system thus structured is a significant characteristic of the present invention.

Detailed Description Text (32):
Using the light conductive prism 94 described above, the photoelectric conversion element 107 can be miniaturized efficiently. FIG. 14 illustrates this state. In FIG. 14, a reference numeral 107 designates a photoelectric conversion element. The pixel arrays 108a1 to 108e2 correspond to the metering fields 104a to 104e, and the pixel arrays 108f1 to 108j2 correspond to the metering fields 104f to 104j. The meaning of the subscript reference marks are the same as those described in conjunction with FIG. 13. Here, the pixel arrays 108f1 to 108j1 and 108f2 to 108j2 corresponding to the metering fields 104f to 104j are positioned in a area sandwiched between the pixel arrays 108a1 to 108e1 and 108a2 to 108e2 corresponding to the metering fields 104a to 104e, and there is no wasteful area. The introduction of the light conductive prism 94 enables the efficient miniaturization of the camera main body itself by holding the optical path, not to mention the cost advantage brought about by the reduced size of the photoelectric conversion element itself.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC | Draw Desc | Image

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☐ 6. Document ID: US 5140462 A

L15: Entry 6 of 11 File: USPT Aug 18, 1992

DOCUMENT-IDENTIFIER: US 5140462 A
**** See image for Certificate of Correction ****
TITLE: Optical system having image deflecting function

Brief Summary Text (3):
This invention relates to photographic system having image deflecting means and, more particularly, to a photographic system having image deflecting means in which by using a variable vertical angle prism provided in a lens system, an image blur caused by camera shake, etc. is compensated for to stabilize a photographic image, and which is suited for cameras for photography or video cameras.

Brief Summary Text (26):
Accordingly, in the vibration proof optical system using the variable vertical angle prism for compensating for the image blur resulting from camera-shake by deflecting the image in the reverse direction, as has been described above, if the decentering distortion is present, the amount of movement of the image at the central point in the image plane differs from those at the marginal points. Even though the compensation for the image blur is perfect in the center of the image frame, it is in the marginal zone that the image would diffuse. FIG. 19(C) is a result of compensation for the blur of the image of the object of FIG. 19(A) by the vibration-proof optical system having the decentering distortion.

Detailed Description Text (4):
In this embodiment, rays of light emerging from the first lens unit I are made almost afocal. When the on-axial beam incident on the variable vertical angle prism P is nearly afocal, in other words, when the angle of inclination .alpha. of the paraxial rays of the on-axial beam is nearly so small as to satisfy a condition: .vertline..alpha..vertline.<0.3<f.sub.T where f.sub.T is the focal length of the entire system, as compared with a case where it is not afocal, the decentering coma, decentering astigmatism and decentering curvature of field produced in the variable vertical angle prism are small. Hence, the correction of the spherical aberration, coma and astigmatism of a partial system of the second lens unit II to a minimum leads, in principle, to a possibility of minimizing the decentering coma, decentering astigmatism and decentering curvature of field produced, and, therefore, of lessening the number of constituent lens elements for the second lens unit II.

Detailed Description Text (63):
where f.sub.T is the focal length of the entire system. Since it implies that a positive lens unit of relatively strong power is arranged in a remote position from the variable vertical angle prism, not only the distortion with which the invention

has its concern, but also other aberrations can be corrected without difficulty. So, when the focal lengths are short as exceeding the lower limits of the inequalities of condition (15) and the inequalities of condition (16), a large number of lens elements for correcting spherical aberration and astigmatism becomes necessary, although it is advantageous for correcting the distortion of each lens unit. Meanwhile, when the upper limits of the inequalities of conditions (15) and (16) are exceeded, the size of the optical system is increased objectionably.

Detailed Description Text (74):
In the invention, it should be understood that the principle of the invention can advantageously be applied even to another type of variable vertical angle prism in which, as shown in FIG. 3, a plano-concave lens P.sub.1 and a plano-convex lens P.sub.2 whose confronting surfaces are spherical with their radius of curvature having almost equal values to each other are rotated along the spherical surface relative to each other.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 7. Document ID: US 4971428 A
L15: Entry 7 of 11   File: USPT   Nov 20, 1990

DOCUMENT-IDENTIFIER: US 4971428 A
TITLE: Catadioptric zoom lens

Brief Summary Text (10):
Briefly stated, the invention in one form thereof comprises from the object end a fixed catadioptric first group having a rear relay lens sub-group which creates an intermediate image, a positive variator, and a negative compensator which maybe followed by a viewing prism. The first catadioptric lens group is designed with a positive petval curvature which when combined with the zooming relay group of the lens, which naturally has a strong negative petzval curvature, provide a good correction of the field curvature, Correction of a astigmatism is also achieved. The dominant remaining aberrations left are spherical and coma. The positive variator group is divided into two subgroups separated by a large air space. The first subgroup has weak power and its main function is to provide a large positive contribution to correction of coma. The second sub group closest to the film plane, provides most of the power of the variator group. The main contributions to correction of spherical aberrations as well as other residual and chromatic aberrations, come from the second subgroup of the variator.

Detailed Description Text (2):
A lens embodying the invention as illustrated comprises a first catadioptric group G1 having a relay subgroup G12. Group G1 is followed by a variator or zooming relay group G2 which is comprised of a first subgroup G21 and a second subgroup G22. Group G2 is followed by a compensating group G3 and a stationery split prism P prior to the focal plane FP. The optical axis of the lens is indicated by the reference letter A. The purpose of the prism is to permit imaging on more than one device. For example, a video imaging device, and a camera.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments   KWIC | Draw Desc | Image

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☐ 8. Document ID: US 4705363 A
L15: Entry 8 of 11   File: USPT   Nov 10, 1987

DOCUMENT-IDENTIFIER: US 4705363 A

TITLE: Aberrational deterioration prevented zoom lens

Brief Summary Text (13):
Meanwhile, in the photographic optical systems for single lens reflex cameras, video cameras and cine cameras, the split prism type of distance measuring means is widely used.

Brief Summary Text (15):
Therefore, if the spherical aberration of the optical system is perfectly corrected, a light flux any height from the optical axis is focused at the same point, permitting distance measuring by the split prism to be accurately performed. Also, even if there is more or less residual spherical aberration, the accuracy of distance measurement can be maintained at some level, provided that the paired light fluxes are the same height from the optical axis. This condition is, however, satisfied only when the center of the eye of the observer coincides with the optical axis. If the eye is out of alignment with the optical axis, the light fluxes used in distance measuring become partial light fluxes of different heights from the optical axis, making it difficult to accurately measure the distance. For example, with the photographic optical system having such a spherical aberration as shown in FIG. 7, there is a situation where one light flux l1 is of a range "b" and the other light flux l2 is of another range "c". Since the focal points of these light fluxes are different from each other, even if the image is in focus on the split prism, the split images appear to be offset, making it impossible to perform accurate distance measurement. When the center of the eye is not out of alignment with the optical axis, the light fluxes, l1 and l2 used are both of the same range "a". But such a situation is here. In most cases, light fluxes different in height from the optical axis are used.

Brief Summary Text (16):
It is to be understood from the foregoing that as most of the zoom lenses used as the photographic optical system have appreciable residual spherical aberration, this spherical aberration lowers the accuracy of distance measurement when the split prism is used for measuring distance.

Detailed Description Text (16):
FIGS. 12A and 12B show a third embodiment, where I is the first lens component for focusing, II and III are the second and third lens components for zooming respectively, and IV is the fourth lens component for forming an image. The first to the fourth lens components I, II, III, IV constitute a zoom lens. Reference symbol S identifies an aperture diaphragm, and ST a stop. An example of a distance measuring system is depicted in FIG. 5B where reference symbol M identifies a half mirror, SP a split prism, F a photographic film, and FD a finder. The opening of the stop ST is formed as shown in, for example, FIGS. 13A to 13F with a pair of expanded portions for restricting light flux symmetrically in at least one direction R.sub.SP. Preferably, in a direction of shorter distance from the optical axis, the on-axial light flux is restricted. The wedge direction R.sub.P of the split prism SP shown in FIG. 5A and the direction R.sub.SP in which the light flux is restricted almost coincide with each other. In FIG. 12A, the stop ST is added to the first lens component I so that it moves during focusing. In general, when focusing is performed by the first lens component I, a most marginal ray B of the on-axial light flux from an object at the minimum distance is incident on the first lens component I at a higher height than that of the incidence of a most marginal ray A of the on-axial light flux from an infinitely distant object (on the assumption that the full open F-number is the same). For example, when in the telephoto end, by the stop ST, the on-axial light flux for the infinitely distant object is not restricted, but the on-axial light flux for the close object can be restricted, thus making it possible to restrict spherical aberration with the close object. That is, because the light flux used in measuring the distance can be cut in portion, accuracy of distance measurement can be increased. The stop ST usable for this purpose may be formed to any shape which is not confined to those shown in FIGS. 13A-13F, providing that at least only one direction is restricted. And, the stop ST at this time is preferably spaced apart from the aperture diaphragm S by a lens system, because the off-axial light flux is not restricted. Though the illustrated embodiment of FIG. 12A has been described in connection with the stop ST movable along with the focusing or first lens component I to restrict the on-axial light flux, the stop ST may be otherwise arranged to move along with one of the lens components I, II, III, IV for zooming, for example, the second II or the third III lens component to restrict the on-axial light flux in zooming, thereby highly accurate distance measurement can be obtained

over the entire zooming range.

Detailed Description Text (18):
The zoom lens shown in FIG. 8A is constructed with, three lens groups of negative, positive and negative refractive powers in this order from the front, the first lens group I being moved to effect focusing, and the first and second lens groups I and II being moved axially but in differential relation to effect zooming. The aperture diaphragm S is provided within the second lens group II. The range of focal length is f=29-82 with the full open aperture 1:4.3. The stop ST is between the second lens group II and the third lens group III in the position P at which the marginal ray L1 of the on-axial light flux corresponding to the full open aperture and the marginal ray L2 of an off-axial light flux going to the extra-axial image point intersect each other on the opposite side of at least one lens group to the aperture diaphragm S. The shape of the opening of the stop ST is similar to that shown in FIG. 13A. That is, the vertical diameter is equal to twice the height of the intersection point P from the optical axis, and the lateral distance is smaller by 10% than the diameter to restrict both sides of the light flux. By using such an arrangement of the stop ST on the opposite side of the lens group to the aperture diaphragm S, the on-axial light flux is effectively restricted without having to influence the off-axial light flux. And, when zooming in a region of f=70-82, the stop ST remains stationary, and when zooming from f=70 to f=29, it is moved rearward. In this embodiment, the spherical aberration of about f= 70 is most rapidly over-corrected near the maximum aperture. Also with the object at a distance of 1.5 m in the telephoto end (focusing being performed by the first lens group), the spherical aberration is rapidly over-corrected. For this reason, the stop ST is used to cut the maximum on-axial light flux in the lateral direction by 10%. Therefore, the spherical aberration is at a height equal to 0.9 times the maximum. As will be understood from the aberration curves of FIG. 14, the spherical aberration for f=70 and f=82 with an object at 1.5 meters if taken at 0.9 becomes a very good spherical aberration. Therefore, when the light flux of lateral direction is used for measuring the object distance with the split prism SP, because the influence of the aberration is lesser in that direction, an accurate measurement of the distance can be made with ease, despite the center of the eye of the observer is more or less taken out of alingment with the optical axis. Also in the region of f=70-82, the speed at the full open aperture is slightly decreased to F-number=4.3827. But this value is only 1.9% slower than 4.3, falling sufficiently in the allowable range. Also the stop restricts the marginal ray of the off-axial light flux to the extra-axial to the intermediate zone of the image, thereby the coma flare is also effectively removed, contributing to an improvement of the image quality.

Detailed Description Text (19):
The zoom lens shown in FIGS. 10A-10D is constructed with four lens groups of positive, negative, positive and positive refractive powers in this order from the front and has a range of f=36-131 with F-number=4.0. An aperture diaphragm lies in a space between the second lens group II and the third lens group III, and moves along with the first lens group I when zooming. The second and fourth lens groups II and IV remain stationary during zooming, and the third lens group III moves. A stop ST lies in a space between the third lens group III and the fourth lens group IV at a location where when in the telephoto end the marginal ray of the on-axial light flux corresponding to the full open aperture and the marginal ray of the off-axial light flux going to the extra-axial image point intersect each other. The shape of the opening of the stop ST is similar to that shown in FIG. 13C likewise as has been described above. And, as zooming in a region of f=70-131, the stop ST remains stationary, and as zooming from f=70 to f=36, it moves rearward. In this embodiment, the spherical aberration of about f=100 is rapidly over-corrected near the maximum aperture. With the telephoto end when focused down to 1.5 m, under-correction of spherical aberration results. For this reason, the aforesaid stop is used to cut the height of incidence from 0.9 to 1.0, so that as the worst portion of the spherical aberration is improved, an accurate measuring of the distance becomes possible easily. Thus, in this embodiment, the stop is made to move from midway of zooming, thereby the light flux is effectively restricted. And, the direction R.sub.SP in which the on-axial light flux is restricted by the stop ST is made almost coincident with the direction R.sub.P of the wedges of the split prism likewise as in the foregoing embodiment, so that a photographic optical system of improved accuracy of distance measurement can be obtained.

☐ 9. Document ID: US 4266849 A

L15: Entry 9 of 11 File: USPT May 12, 1981

DOCUMENT-IDENTIFIER: US 4266849 A
TITLE: Optical objectives

Detailed Description Text (15):
First it passes through plate 44 and proceeds as a to main mirror 30 where it is reflected and passes as b into the corner cube via its concave surface 118. Then the ray is reflected in turn from each of the three flat reflecting surfaces of the corner cube and passes as c out of the concave surface 118 to the center hole 36 of the main mirror. The other light ray 122A follows a similar path and emerges from the corner cube toward the center hole 36 of the main mirror as c'. The light rays converge at a final focus point F.sub.3. The image (which is real and erect) formed at F.sub.3 is magnified by the associated eyepiece or magnifier (not shown). F.sub.1 represents the focal point of the main mirror, F.sub.2 is the image plane that would be formed by light rays passing from main mirror 30 through the corner cube on the first encounter with the corner cube, F.sub.2 ' is the image plane that would be formed by light rays passing out of the corner cube after encountering the three mutually orthogonal surfaces of the prism, and F.sub.3 is the final focus of the system, i.e., it is the surface or plane at which the real and erect image is formed. In FIG. 5, the focal point F.sub.1 coincides with the apex of the corner cube; however, this is not a fundamental functional requirement of the invention. An essential requirement of this embodiment is that the virtual focus of the corner cube cannot coincide with the focus of the main mirror; instead the focus of the main mirror must be between surface 118 and the virtual focus of the corner cube; preferably it is between the apex of the corner cube and surface 118. The virtual focus of the corner cube is affected by the curvature of surface 118. The latter is spherical and its curvature is arranged so as to substantially balance out spherical aberrations of the main mirror. The final focus F.sub.3 of the system may be moved forward or behind the particular point shown in FIG. 5 by appropriate design of surface 118.

Detailed Description Text (25):
FIG. 7E shows a system wherein the corner cube reflector 46C is disposed in an aperture in a concave-concave lens 152 and has its apex extending into a central cavity in a convex-concave lens 154. The opposite end of reflector 46C is flat and engages a planar lens 156 which is disposed centrally of and in contact with a convex-concave lens 158. Additionally, the main mirror 30 is replaced by a flat main mirror 30B. This system may be used as a camera lens, microscope or a special purpose optical measurement instrument. It is highly corrected for spherical aberration, coma, astigmatism and color, and telephoto magnification is provided by the compound powered prism. Use of a flat primary mirror gives the system thermal stability since all of the power (exclusive of the associated eyepiece) is located at one place. In FIG. 7F the corner cube reflector 46C is disposed in a central aperture in a concave-convex lens 160 and its apex is disposed in a central aperture in a convex-concave front lens 162. The main mirror 30 is replaced by a flat main mirror 30B. This system is useful as a lens system for less expensive instruments and cameras. The doublet permits correction for sphercial aberrations and coma, and the front step 19A removes astigmatism. Use of a flat primary mirror gives the system a high thermal stability since all of the power (exclusive of the associated eyepiece) is concentrated at one location.

Detailed Description Text (44):
A system constructed according to the foregoing design criteria has an aperture of 25.4 mm (i.e. 1.0 inch) with a real field of view of 6.degree., and will exhibit an approximate magnification power of 6.times. when used with an eyepiece having a focal length of 10.311 mm. The focus of the system i.e., F.sub.3, is located 0.4743 inches from the vertex of curved surface 118 and the image will be real and erect and be substantially free of spherical and chromatic aberrations as well as being substantially fully corrected for coma, distortion and astigmatism. It is to be noted also that proper design of the curvature of surface 118 not only provides

color correction but also permits a reduction in the size of the corner cube prism. This system makes it possible to provide an instrument light enough to wear and less than two inches long with fields of view of from 6.degree. to 9.degree. and power ranges of 4.times. to 10.times..

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☐ 10. Document ID: US 4097141 A
L15: Entry 10 of 11   File: USPT   Jun 27, 1978

DOCUMENT-IDENTIFIER: US 4097141 A
TITLE: Optical objectives using apertured retrodirective reflectors

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☐ 11. Document ID: US 3886331 A

L15: Entry 11 of 11 File: USPT May 27, 1975

DOCUMENT-IDENTIFIER: US 3886331 A

**** See image for Certificate of Correction ****

TITLE: Electronic scanning spectrophotometer system

Detailed Description Text (2):

As shown in FIG. 1, one embodiment of the spectorphotometer system of the present invention has a conventional optical system including an entrance slit 10, a first spherical mirror 12, a movable diffraction grating 14, and a second spherical mirror 16. This can be a "coma corrected Czerny-Turner" optical system like that shown in U.S. Pat. No. 3,011,391 of W. G. Fastie granted Dec. 5, 1961. An input light signal 18 containing light of many different wavelengths is transmitted through the slit in the entrance slit member 10 and is collimated and reflected by mirror 12 onto the diffraction grating 14. The diffraction grating diffracts the light at different angles according to its wavelength and the output mirror 16 focuses this light thereby transforming this angular dispersion into a linear dispersion at a focal plane 20 where a photoelectric detector 22 is positioned. Thus, detector 22 may be an image tube having a photosensitive target positioned in the image plane 20. The image tube 22 is preferably a vidicon type television camera tube having a photosensitive target in the form on a PN junction silicon diode array as shown in U.S. Pat. No. 3,011,089 of F. W. Reynolds granted Nov. 28, 1971, or a metal to semiconductor diode array like that of U.S. Pat. No. 3,496,404 of P. H. Wendland granted Feb. 17, 1970. Of course, other optical systems can be employed and a prism or other wavelength separating element substituted for the diffraction grating 14. It should be noted that the diffraction grating 14 can be pivoted by means of a wavelength drive knob 24 to change the incident angle at which the input light signal strikes such diffraction grating so that the portion of the optical spectrum focused upon the image plane 20 of the detector tube 22 changes with different settings of knob 24.

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